NOTES

The American Element in the Hawaiian Flora[1]

The geographic derivation of any flora is a matter of interest not only to taxonomists and phytogeographers but also to students of geology and geography and to those with a general intellectual curiosity as well. Reliable speculation on such a subject often provides useful keys to other related topics such as the geological history of an area, its paleoecology, the migrations of its peoples, and the phylogeny of special groups of plants.

The floras of oceanic islands seem to be particularly stimulating to such speculations, and that of the Hawaiian Islands has had its full share of theories. Hillebrand, Brown, Campbell, Skottsberg, and Copeland are among those who have expressed opinions. The latest such expression that I know of was presented by me, two years ago (in E. C. Zimmerman's *Insects of Hawaii* 1: 107–119, 1948). The outstanding characteristic of this collection of opinions is its diversity. Hillebrand and Brown, especially, recognized a large element of American affinity. Later writers have rather minimized this.

My own approach differed from that of most earlier writers in being an attempt to ascertain the number and derivation of the probable original successful colonists responsible for the present indigenous Hawaiian flora. The percentage of each element in the present flora was then determined on the basis of these original colonizations rather than of the total present flora. This, it was felt, would eliminate the disproportion introduced by such rapidly evolving groups as *Cyrtandra*, the Rubiaceae, the lobeliads, *Metrosideros*, etc. It is thought that there were about 407 such successful colonists.

The percentages of the floristic elements in the vascular flora, recognized on this basis, are as follows:

REGION	PERCENTAGE
Indo-Pacific	42.7
Austral	12.2
American	16.2
Boreal	3.1
Pantropic	15.4
Obscure	10.5

The figures for the seed plants and vascular cryptogams were originally published separately, but are here combined. For the American element the seed plant percentage is 18.3 and that of the pteridophytes, 11.9. There were possibly a total of 69 original successful immigrants from America, of which 51 were seed plants and 18 pteridophytes.

Now, let us look at some of the interesting features of this American element.

Of the total of 69 possible American introductions, 40, or about 58 per cent, have changed very little since their arrival. Twenty-one are identical or only varietally distinct from their American relatives. Nineteen are closely related species. Of the other 42 per cent, 19 species are clearly, though not closely, related to American plants; the remaining 10 may be regarded as questionable. I am on insecure ground when discussing certain of the larger fern genera where the Hawaiian species may be closer to American ones than I realize.

Of the total American component, only four genera, *Isodendrion*, *Nothocestrum*, *Psychotria*, and *Hesperomannia*, have given rise to any significant number of evolutionary off-

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shoots that still survive, and none has produced a large number. Furthermore, all these genera are among the more doubtfully American of the lot.

There are only two strand species in the American element—*Lycium carolinianum* and *Jacquemontia sandwicensis*. *Chenopodium oahuense* grows at sea level as well as in dry uplands. Of course, some of the pantropic strand plants may be of American origin.

Of the total, only *Sapindus* and *Psychotria* have seeds too large to be easily distributed by wind.

There are about eight cases of probable bird dispersal—plants whose seeds logically might have stuck to birds' feet or feathers. Prominent among these is *Fragaria chiloensis*, which grows on sea beaches from Chile to Alaska and in the uplands of the island of Hawaii. Alaska is the summer home and Hawaii the winter home of the Pacific plovers and curlews. In addition to these, there are about eight other plants with fleshy fruits which may have been brought in birds' intestines, though this is less likely over such distances.

Human agencies cannot be absolutely excluded in about 10 cases, though the possibilities have been carefully weighed, and only about 2 of these 10 are regarded as at all likely. Those that seem really to have entered Hawaii by human introduction have been excluded as non-indigenous. One cannot positively exclude very early historical introduction for a few plants, such as *Hesperocnide* and *Daucus*, or prehistoric human transport for such as *Argemone;* but it is unlikely. The *Hesperocnide* is considered an endemic species and the *Argemone* an endemic variety of *Argemone alba*.

Gossypium tomentosum is a special case. Cytological investigations by Hutchinson, Stephens, and Silow have led them to the conclusion that this species and the two widespread cultivated American cottons form a closely related group derived by hybridization between an Asiatic cotton and a wild diploid American cotton. They think that this hybridization followed prehistoric human introduction of an Asiatic cotton into America (where it does not now persist), and that *Gossypium tomentosum* was then carried back to Polynesia and to Hawaii by Polynesian travelers.

There are several weaknesses inherent in this theory. Even supposing that the Polynesians had made such voyages, it seems scarcely likely that they would have selected for taking back the one perfectly useless cotton of the three, or that it would not have persisted elsewhere along the route in Polynesia. The fiber of *Gossypium tomentosum* is only a few millimeters long. The greatest cause for doubt, however, lies in Dr. Silow's statement (in conversation, 1949) that *Gossypium tomentosum* is closely related to the cultivated cottons. Morphologically, at least, this does not seem to be true. T. H. Kearney, long an authority on cottons, has told me that he regards it as closest to a wild species of the Galapagos Islands. I am well acquainted with *Gossypium tomentosum* and with both cultivated American cottons and find little similarity.

I suggest that *Gossypium tomentosum* be reexamined cytologically, using material about whose origin and identity there can be no doubt. It may be that there has been a confusion with the forms of *Gossypium barbadense* that have long been introduced and established in Hawaii.

To return to general considerations, it seems fairly safe to assume that identity or close relationship with American species indicates that isolation from them has not been of very long standing. The lack of extensive evolutionary differentiation suggests the same thing. It is realized, of course, that there may well be exceptions to these generalizations. But when almost 60 per cent of the presumed American stocks in the flora are identical with or very close to their American relatives, and when over 94 per cent have not given rise to any number of evolutionary progeny,

and when the largest number of species and varieties in any one of the stocks is less than a dozen, and that in *Psychotria*, one of the rather questionably American members, one may draw certain conclusions with some confidence. It would seem safe, at least, to say that the American element, generally, is a comparatively late addition to the Hawaiian flora. It would be premature to speculate on the significance of this until all of the other elements of the flora have been examined in a comparable manner.—*F. R. Fosberg, Pacific Vegetation Project, Catholic University of America, Washington, D. C.*

News Notes

On March 9 and 10, 1951, about 130 of the leading scientists of Hawaii met in Honolulu at the invitation of the Hawaiian Academy of Science to discuss the status of scientific research in the Pacific and to make recommendations for further work.

At the initial general meeting, brief summaries were given of the research activities of various scientific organizations represented in Hawaii.

Dr. L. D. Baver, vice president of the Academy, directed the general session in the absence of the president, Dr. E. C. Auchter.

For purposes of discussing the problems of their particular interest, the scientists were organized into the following eleven committees which convened in meeting places provided by the Pineapple Research Institute and the neighboring University of Hawaii, Pacific Oceanic Fishery Investigations building of the U. S. Fish and Wildlife Service, and the Institute of Pacific Relations:

COMMITTEE	CHAIRMAN
Geology, Geophysics, and Hydrology	Doak C. Cox
Meteorology	W. A. Mordy for R. H. Simpson
Oceanography and Zoology	A. L. Tester
Entomology	C. E. Pemberton
Conservation	L. D. Baver
Museums in Pacific Research	E. H. Bryan, Jr.
Soil Survey and Land Classification	Z. C. Foster
Crop Improvement and Soil Management	J. L. Collins and J. H. Beaumont
Animal Improvement	Sam B. Nordfeldt
Anthropology and Social Sciences	Leonard D. Mason
Health and Nutrition	C. L. Wilbar

More than 150 recommendations were presented by these committees at the concluding general session and were adopted by the combined group with but slight modification. Most of these recommendations have specific application to Hawaii, but several are concerned with Micronesia and other Pacific island groups. Many should be of interest to committees preparing for the Eighth Pacific Science Congress. The results of the symposium will be published in the *Proceedings of the Hawaiian Academy of Science* following the annual meeting in May.

In planning and carrying out this symposium, generous help was given to the officers of the Hawaiian Academy of Science by the Secretariat of the Pacific Science Council.

If this symposium accomplished no more than the convening of so many of the scientists of Hawaii, to help them discuss their mutual interests and problems, it will have been worth while; but it is believed that putting on record such a summary of scientific needs and goals may do much to stimulate scientific work in the Pacific.—*E. H. Bryan, Jr., Secretary, Hawaiian Academy of Science.*

GARNIER, B. S., Ed. *New Zealand Weather and Climate.* 154 pp., 14 figs. Misc. Series No. 1, New Zealand Geographical Society, Auckland, New Zealand.

As a series of essays on related topics rather than an organized work progressing through the subjects from start to finish, this booklet presents some very concise and informative material on the New Zealand climate.

All the papers are in readable, descriptive terms and cover a history of the New Zealand Weather Service from its beginning in 1859 to the present day, a description of the geographical and seasonal variations of New Zealand climate, and a classification of these climates according to the Thornthwaite system. The compilation includes several papers which have appeared elsewhere as well as several new discussions to make up the first in a series of special publications by the newly formed New Zealand Geographical Society. Accompanying data and figures give average monthly and annual rainfall and temperature figures for principal weather stations and mean annual rainfall maps for a 35-year period of record. Other figures include maps of rainfall variability and charts of rainfall, hail and fog frequency, prevailing wind, temperatures, etc., for related stations.

Of primary interest to meteorologists will be the discussion of forecasting New Zealand weather by Ian M. Watts. The author makes use of an unusual illustrative technique in describing the weather and cloud distributions associated with the various types of meteorological disturbances passing through the country. These are in the form of photographs of relief maps over which tufts of cotton representing clouds have been placed. These photographs give the reader an excellent picture of an area with which he is likely to be unfamiliar, thus allowing him to follow the discussion readily.

Although the editor makes apologies for publishing a book on "such a small and sparsely populated country as New Zealand," this book represents a type of information which should be available for a great many more areas of the world. It is happy to note in this respect that this is only the first of a series of publications designed to provide an outlet for geographical research on the New Zealand Area—W. A. Mordy.

TAYLOR, WILLIAM RANDOLPH. *Plants of Bikini and Other Northern Marshall Islands.* University of Michigan Studies, Scientific Series, Vol. 18: xv+227 pp., color frontispiece, 79 plates. University of Michigan Press, Ann Arbor, 1950. $5.50.

Dr. Taylor's attractive book is the account of his plant collections made on "Operation Crossroads" preliminary to the atomic bombing of Bikini Atoll. Excluded are the phytoplankton and the bacteria; included are 181 algae, 12 fungi, 6 lichens, 1 moss, and 56 flowering plants.

The introductory chapters include: previous botanical exploration of the Marshall Islands; descriptions of the atolls and their marine flora; characteristics of the land flora; and detailed botanical features of the atolls studied—Rongerik, Rongelap, Bikini, and Eniwetok.

The remaining text consists of a systematic account of the plant species. For Cryptogams there is given the class name, the family name, the generic name, its authority and date, the binomial and authority, a description (often full and detailed), a discussion of the habitat and special features or relationships, and a citation of collections by islands. Synonyms are conspicuously lacking, as is the reference to the place of publication of the accepted name of the species or taxon. The full Latin diagnoses of the new plants are in an appendix.

For the Spermatophyta the treatment is similar. It is possible from clear statements or implications to calculate that the higher plants consist of 40 indigenous, 8 adventive, 5 crop, and 3 cultivated ornamental plants. The descriptions are full and the localities definite. After each generic heading is given the authority, but the date (which was given in the Cryptogams) is here omitted.

In the nomenclature there are numerous inadequacies. If the pre-Linnaean author Plumier is to be credited with the genus *Pisonia* (p. 177), as was done by Linnaeus himself, it should be written Plumier ex Linnaeus, and so, too, should the same authority be credited for *Hernandia* (p. 181), *Suriana* (p. 183), *Triumfetta* (p. 186), *Cordia* (p. 194), and *Ximenia* (p. 198). Similarly the full author citation for the following genera should be: *Eragrostis* (p. 164) Palisot de

Beauvois (not Beauvais), *Setaria* (p. 167) Palisot de Beauvois, *Clerodendrum* (not *Clerodendron*) (p. 196) Burman ex Linnaeus, *Morinda* (p. 200) Vaillant ex Linnaeus. Also *Boerhaavia* (p. 176) should be *Boerhavia* (the original and valid spelling), and *Allophyllus* (p. 185) should read *Allophylus*.

In the authorities for the species, there are also inaccuracies. The several species credited to Forster on pages 164, 168, 175, 176, 186 should be credited to Forster filius (J. G. A. Forster). *Tacca leontopetaloides* was not authored by (Linnaeus) Merrill, but by (Linnaeus) O. Kuntze. *Sida fallax* (p. 187) was not published by Walpole, but by Walpers.

From the earliest voyages to the present, all explorers have admired the completeness of knowledge of the larger plants by the native Pacific peoples. Ethnobotanical information as to vernacular names and the uses of the plants is almost wholly lacking in this book, except for a few notes on *Cocos* and *Tacca*. This is regrettable since the people of Bikini have now been removed and no record was made of their local plant lore. The omission is probably due to "military restrictions to prevent interference with native residents" (p. 19).

Taylor does not explain the kind of book or the reading public he had in mind. It is clearly not a book for popular reading, but is a technical botanical book. It does not seem to be provided for the specialists who know much of the Pacific flora and have at hand the basic literature and large Pacific plant collections, since for these very few individuals, there would be no point in printing descriptions of all the previously known species. Hence, the book appears to have been written as a combined technical and semi-popular one, for the many naturalists interested in the Pacific and for the officials or travelers who visit the general area. To these the description and detailed distribution of each species will be of value. But, for those species not illustrated, the student will find identification unnecessarily arduous, since there are no general keys, and none at all except for the genera *Caulerpa*, *Halimeda*, and *Liagora*.

Taylor knew of the details of the vegetation of the southern Marshall Islands only from the accounts by Volkens and by Koidzumi of the single atoll Jaluit. From this basis he compares (p. 3) the flora of the two extremes and concludes that the southern atolls are notable by the "apparent absence of *Suriana*, *Fimbristylis*, *Tacca*, *Pisonia*, *Boerhaavia*, *Dodonaea*, *Clerodendron*, *Ochrosia*, and other genera." We now have collections verifying the occurrence of *Dodonaea* on Wotje, and all the other genera listed by Taylor as missing we now know on several of the southern atolls; actually all but one of the remainder occur on Jaluit, and all but two on the southernmost atoll of the group, Ebon. Hence, the comparison, quoted above, was premature and not a true one.

Nevertheless, Taylor's *Plants of Bikini* is a welcome addition to the accounts of the Pacific flora, giving excellent topographic and vegetational accounts, a good summary of the terrestrial flora, and an original and detailed systematic presentation of the lower plants, particularly the marine algae. It is worth the price.—Harold St. John.

Japanese Journal of Ichthyology (*Nihon Uo Zasshi*), published by the Japanese Society of Ichthyologists (Uo no Kai), Zoological Institute, Faculty of Science, Tokyo University, Hongo, Tokyo, Japan.

This is a new Japanese journal, the first number of which was released on August 20, 1950. The Journal will appear bimonthly, and will present scientific articles, reviews, comments, editorial notes, and news items. Most of the articles in the first issue are written in Japanese, with résumés in English; a few articles are written entirely in English. The chief editors are T. Abe, H. Arai, N. Y. Kawamoto, Y. Okada, and K. Suyehiro.